Fig.1

IMAGE PICK UP LOCATION

POLISHING LOCATION

100

22

M

22

M

20

WF

10

32

30

CAMERA

12

M

40

42

IMAGE CHARACTERISTIC VALUE CALCULATOR

50

44

POLISHING END POINT DETERMINATOR

IMAGE DATA

Fig.2A FORMING Cu LAYER

Cu LAYER
TaN LAYER
OXIDE LAYER

REMOVING Cu LAYER

Fig.2B FIRST CMP PROCESS

TaN LAYER
OXIDE LAYER

DELETING TaN
SURFACE LAYER

Fig.2C SECOND CMP PROCESS

OXIDE LAYER

Fig.3

```
        ┌─────────────────────┐
        │        START        │
        └─────────────────────┘
                   │
                   ▼
   ┌─────────────────────────────┐      S1
   │       FORM THIN FILM         │
   └─────────────────────────────┘
                   │
                   ▼
   ┌─────────────────────────────┐      S2
   │  POLISH FOR A CERTAIN PERIOD │
   └─────────────────────────────┘
                   │
                   ▼
   ┌─────────────────────────────┐      S3
   │        PICK UP IMAGE         │
   └─────────────────────────────┘
                   │
                   ▼
   ┌─────────────────────────────┐      S4
   │      CALCULATE IMAGE         │
   │    CHARACTERISTIC VALUE      │
   └─────────────────────────────┘
                   │
                   ▼
            ╱─────────────╲            S5
           ╱  END POINT    ╲
     No   ╱   REACHED?      ╲
    ◄─────╲                 ╱
           ╲               ╱
            ╲─────────────╱
                   │ Yes
                   ▼
        ┌─────────────────────┐
        │        END          │
        └─────────────────────┘
```
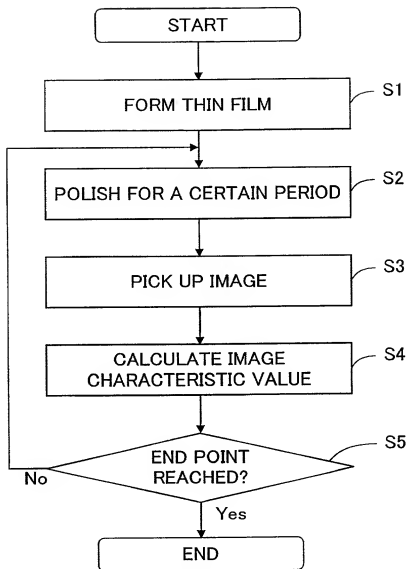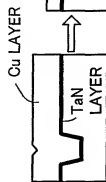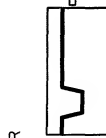
Fig. 4A
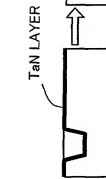BEFORE POLISHING

Fig. 4B
PLANARIZING
Cu LAYER

Fig. 4C
STARTING TO
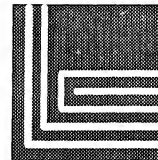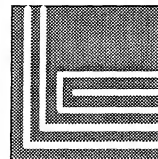DETECT WIRING
PATTERN

Fig. 4D
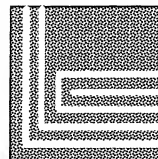APPROPRIATE
POLISHING

Fig. 4E
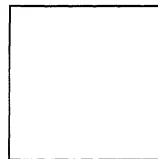EXCESSIVE
POLISHING

Cu LAYER

TaN LAYER

TaN LAYER

Fig.5

FUZZY ENTROPY H2

0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0

ENTROPY H1

8 7 6 5 4 3 2 1 0

POLISHING TIME

H1max

H2max

H1

H2

Δt1

t0 t1
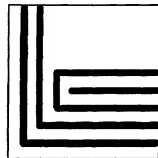
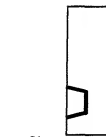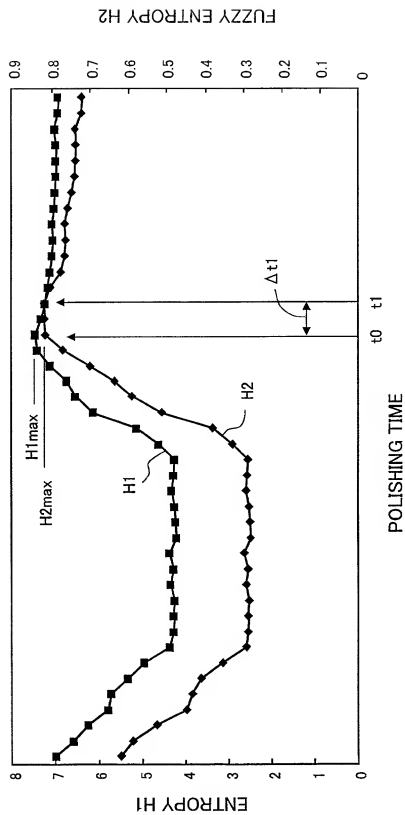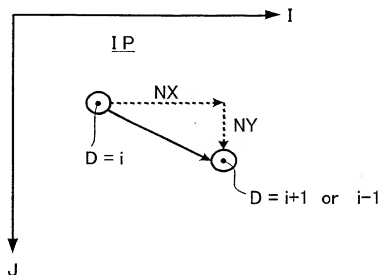*Fig.6*

CALCULATION OF HISTOGRAMS G(i),
P(i) USED IN DIFFERENCE STATISTIC
OF GRAY IMAGE

HYSTOGRAM G(i):
Probability that an absolute value of a difference of
image values D of two pixels separated by (NX, NY)
has a value of i.

P(i) = G(i+1)

Fig. 7

DIFFERENCE STATISTIC CONTRAST F1

POLISHING TIME

F1

F1min

t0' t1

Δt2